

GAS CHROMATOGRAPHIC CONCEPTS FOR THE ANALYSIS OF PLANETARY ATMOSPHERES

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Over the last few years, new GC concepts have been developed for use on board spacecraft or any other restricted environments for determining the chemical composition of the atmosphere and surface material of various planetary bodies. Future NASA missions include an entry probe that will be sent to Titan and various spacecraft that will land on Mars. In order to be able to properly respond to the mission science requirements and physical restrictions imposed on the instruments by these missions, GC analytical techniques are being developed in our Branch. Some of these techniques include hardware and mathematical techniques that will improve GC sensitivity and increase the sampling rate of a GC descending through a planetary atmosphere.

The technique of Multiplex Gas Chromatography (MGC) is an example of a technique that was studied in a simulated Titan atmosphere. In such an environment that atmospheric pressure at instrument deployment is estimated to be a few torr. Thus, at such pressures the small amount of sample that will be acquired might not be enough to satisfy the detection requirements of the gas chromatograph. In MGC many samples are pseudo-randomly introduced to the chromatograph without regard to elution of preceding components. The resulting data is then reduced using mathematical techniques such as cross-correlation or Fourier Transforms. Advantages realized from this technique include: improvement in detection limits of several orders of magnitude and increase in the number of analyses that can be conducted in a given period of time.

Results proving the application of MGC at very low pressures emulating the same atmospheric pressures that a Titan probe will encounter when the instruments are deployed will be shown. The sample used contained hydrocarbons that are expected to be found in Titan's atmosphere. In addition, a new selective modulator was developed to monitor water under Martian atmospheric conditions. Since this modulator is selective only to water, the need for a GC column is eliminated. This results in further simplification of the instrument.